U.S. FISH AND WILDLIFE SERVICE
SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

SCIENTIFIC NAME: Cicindela highlandensis Choate

COMMON NAME: Highlands tiger beetle

LEAD REGION: 4

INFORMATION CURRENT AS OF: October 2005

STATUS/ACTION:
___ Species assessment - determined species did not meet the definition of endangered or threatened under the Act and, therefore, was not elevated to Candidate status
___ New candidate
_X_ Continuing candidate
___ Non-petitioned
_X_ Petitioned - Date petition received: May 11, 2004
__ 90-day positive - FR date:
__ 12-month warranted but precluded - FR date:
__ Did the petition request a reclassification of a listed species?
FOR PETITIONED CANDIDATE SPECIES:
a. Is listing warranted (if yes, see summary of threats below)? _yes
b. To date, has publication of a proposal to list been precluded by other higher priority listing actions? _yes
c. If the answer to a. and b. is "yes", provide an explanation of why the action is precluded. We find that the immediate issuance of a proposed rule and timely promulgation of a final rule for this species has been, for the preceding 12 months, and continues to be, precluded by higher priority listing actions (including candidate species with lower LPNs). During the past 12 months, almost our entire national listing budget has been consumed by work on various listing actions to comply with court orders and court-approved settlement agreements, meeting statutory deadlines for petition findings or listing determinations, emergency listing evaluations and determinations, and essential litigation-related, administrative, and program management tasks. We will continue to monitor the status of this species as new information becomes available. This review will determine if a change in status is warranted, including the need to make prompt use of emergency listing procedures. For information on listing actions taken over the past 12 months, see the discussion of "Progress on Revising the Lists," in the current CNOR which can be viewed on our Internet website (http://endangered.fws.gov/).
___ Listing priority change
Former LP: ___
New LP: ___
Date when the species first became a Candidate (as currently defined): October 25, 1999

___ Candidate removal: Former LP: ___

___ A – Taxon is more abundant or widespread than previously believed or not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status.
___U – Taxon not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species.
___ F – Range is no longer a U.S. territory.
___ I – Insufficient information exists on biological vulnerability and threats to support listing.
___ M – Taxon mistakenly included in past notice of review.
___ N – Taxon does not meet the Act's definition of "species."
___ X – Taxon believed to be extinct.

ANIMAL/PLANT GROUP AND FAMILY: Insects, Cicindelidae

HISTORICAL STATES/TERRITORIES/COUNTRIES OF OCCURRENCE: Florida, U.S.A.

CURRENT STATES/COUNTIES/TERRITORIES/COUNTRIES OF OCCURRENCE: Florida, Highlands and Polk Counties, U.S.A.

LAND OWNERSHIP
The Highlands tiger beetle has been documented at the following sites: Allen David Broussard Catfish Creek State Park Preserve, part of Florida State Parks; Snell Creek South, part of Lake Wales Ridge National Wildlife Refuge (NWR); Flaming Arrow Boy Scout Ranch, a private camp; Tiger Creek Preserve, owned by The Nature Conservancy; Carter Creek A, part of Lake Wales Ridge NWR; Flamingo Villas, part of Lake Wales Ridge NWR; Horse Creek scrub, owned by South Florida Water Management District; Walk-in-the-Water Tract, Mary Moser, part of Lake Wales Ridge State Forest; and Snell Creek North, owned by South Florida Water Management District.

LEAD REGION CONTACT: Richard Gooch, 404-679-7124, Richard_gooch@fws.gov

LEAD FIELD OFFICE CONTACT: South Florida Ecological Services Office, Paula Halupa, 772-562-3909 ext 257, Paula_Halupa@fws.gov

BIOLOGICAL INFORMATION:

Species Description: The Highlands tiger beetle (*Cicindela highlandensis*) is a member of the beetle family Cicindelidae (tiger beetles), which includes more than 2,000 species worldwide, more than 100 in the United States (Pearson and Cassola 1992), and about 25 in Florida (Knisley and Hill 1992a). Adult tiger beetles are medium-sized, elongate beetles, mostly with brilliant metallic green, blue, red, and yellow coloration highlighted by stripes and spots. The Highlands tiger beetle is 10.5-12 millimeters long (0.4-0.5 inches) (Knisley and Hill 1992a, Deyrup 1994). The Highlands tiger beetle and its nearest relatives are exceptions, being mostly black. Adult tiger beetles are ferocious, swift, and agile predators that seize small prey with powerful sickle-

shaped jaws (Pearson and Cassola 1992). In Florida, their prey is typically ants (Choate 1984).

Tiger beetle larvae are also predatory. They live in small burrows from which they lunge and seize passing invertebrate prey (Eissig 1926, Eissig 1942, Pearson 1988). When a prey item passes near a burrow, the larva grasps it with its strong mandibles (mouthparts) and pulls it into the burrow, and feeds (Eissig 1942, Pearson 1988). Tiger beetles share similar larval body forms throughout the world (Pearson and Cassola 1992). The larvae, either white, yellowish, or dusky in coloration, are grub-like and fossorial (subterranean), with a hook-like appendage on the fifth abdominal segment that anchors the larvae inside their burrows.

Tiger beetle larvae undergo three instars (larval development stages). This period can take 1 to 4 years, with a 2-year period being the most common (Pearson 1988). The Highlands tiger beetle has a 1-year life cycle (Knisley and Hill 1996). Adults begin to emerge from mid- to late-May, reaching peak abundance about mid-June, then declining in numbers from mid-July onward. Only a few adults survive into late August and early September. Adults mate and begin oviposition (egg-laying) within about two weeks of emergence. First-instar larvae begin to appear in late June and reach peak abundance from late July to early August. Survivors develop to the second instar within 2 to 4 weeks. Second instars, which are at peak abundance from late August to October, require about 4 to 8 weeks to develop to the third instar. Third instars can be found from August through the following spring. This stage requires more food and lasts at least several months. Many third instars may nearly complete their development by December or January, but will occasionally open their burrows until they pupate. Pupation occurs in April or early May, although some larvae of a cohort (probably less than 15 percent) will lag in their development and emerge after two years of development (Knisley and Hill 1996).

Survivorship of Highlands tiger beetle larvae from first instar through the third instar ranged from about 10 to 22 percent at the three sites that Knisley and Hill studied for two years. The highest mortality to larvae was during their first few months, August to October. Predation by ants that took over the burrows was largely restricted to first instars. Parasitism from bee flies (*Anthrax*) was a significant mortality factor for third instar larvae; most samples of larvae dug by Knisley and Hill had parasitism rates over 15 percent, a rate similar to those found for other species of tiger beetle (Knisley and Hill 1996, Knisley 1987). Knisley and Hill also saw a small parasitic wasp, apparently *Methocha*. Robber flies (family Asilidae) were common at all of the study sites, and appear to be the major predators of adult Highlands tiger beetles.

A large body of scientific literature is devoted to tiger beetles, and a tiger beetle scientific journal, Cicindela, has been published since 1969. Scientists have studied the diversity and ecological specialization of tiger beetles, and amateur collectors have long been attracted by their bright coloration and swift movements. Tiger beetle species occur in many different habitats including riparian habitats, beaches, dunes, woodlands, grasslands, and other open areas (Pearson 1988, Knisley and Hill 1992a). A common habitat component appears to be open, sunny areas that are used for hunting and thermoregulation (adaptive behavior to use sunlight or shade to regulate body temperature) (Knisley et al. 1990, Knisley and Hill 1992a).

Taxonomy: Choate (1984) described the Highlands tiger beetle as a new species in a paper that

also dealt with two similar species, *C. scabrosa* (the Florida scrub tiger beetle) and *C. abdominalis*. These three species constitute the "*C. abdominalis* group." The three species are similar, very small and black (with green, blue, and purple reflections), with an orange abdomen visible from the underside. They can be distinguished by several prominent features. The elytrya (leathery forewings) of *Cicindela abdominalis* are shallowly punctured; *Cicindela scabrosa* deeply punctured, and *Cicindela highlandensis* glabrous (i.e., without the punctures). The Highlands tiger beetle also lacks conspicuous white flattened hairs on both sides of the thorax and the underside of the abdomen. We have carefully reviewed the available taxonomic information to reach the conclusion that the species is a valid taxon.

Habitat: The Highlands tiger beetle is often associated with evergreen scrub oaks, as well as high pineland with deciduous turkey oak (*Quercus laevis*) and longleaf pines (*Pinus palustris*). Knisley and Hill (1996) view high quality habitat as primarily scrub or pine woodland with a high percent of open sand (greater than 50 percent) and with many natural openings which are continuous or connected to adjacent open patches, or connected by lightly disturbed trails or paths. Adult Highlands tiger beetles were never found in areas of dense scrub (except along the edges of trails) nor in areas of low shrubs (Knisley and Hill 1996). The Highlands tiger beetle was regularly found on trails with evidence of at least moderate off-road vehicle traffic and where there was evidence of past vegetation clearing or other ground disturbance (Knisley and Hill 1992a, 1996). This suggests that because of fire suppression, the vegetation has become artificially dense, harming the beetle and other species. The need for prescribed burning of the vegetation or alternative methods of clearing openings, such as scraping with a bulldozer, as Knisley and Hill (1996) and Knisley (2005) suggested, and other management measures are discussed in the "threats" section.

Results from surveys conducted during 2004-2005 by Knisley (2005) support previous conclusions that the Highlands tiger beetle occurs in a diversity of habitats and that there are no key plant or other specific indicators of habitat, other than open sandy areas within or adjacent to pine-oak woodlands or scrub. Amount of open area was usually the primary indicator of suitable habitat at the sites (Knisley 2005). Knisley (2005) found adults to be most common along the middle and immediate edges of trails and paths, while larvae were more common on the trail edges, closer to vegetation. This suggests that adults use the open trails for thermoregulation and foraging, but move away from these areas to oviposit in more shaded microhabitats (Knisley 2005).

Among the best sites (i.e., those with the largest numbers of beetles) were typical Lake Wales Ridge scrub with naturally open interior areas (Catfish Creek and Flaming Arrow Scout Camp), scrub sites with open sandy roads or edges caused by human disturbance (Walk-in-Water, Carter Creek sites, Flamingo Villas), and pine flatwoods and longleaf pine sites with either natural or disturbed areas (Snell Creek, Catfish Creek) (Knisley 2005). At the Catfish Creek which has the largest population of the Highlands tiger beetle, adults were widespread and occasionally abundant in trails and open areas of scrub, in sandhill habitat, and on trails adjacent to wet prairie and depression marshes (Knisley 2005).

Historical Range/Distribution: Because the Highlands tiger beetle has only been known since it

was described in 1984, there are no records of its past distribution and abundance in Florida. It seems likely that it was common, widespread, and well established throughout the scrub and possibly high pine communities of the Lake Wales Ridge in Highlands and Polk counties prior to the widespread destruction of these habitats over the past 50 years (Knisley and Hill 1992).

Current Range/Distribution: Knisley and Hill (1996) found the Highlands tiger beetle at 40 sites, 25 in Polk County and 15 in Highlands County, an increase from the 23 sites reported by Knisley and Hill (1992a) but not representing a substantial increase in geographic range. The 40 sites are all on the Lake Wales Ridge, the hilly upland along U.S. Highway 27 that is known for scrub vegetation, endemic plants, and endemic lizards. The range of the Highlands tiger beetle does not extend to the south end of the Ridge, and that the range does extend northward to near Haines City (Knisley and Hill 1996). Knisley and Hill (1996) also note that "a number of tiger beetle collectors have sought but not found this species in other areas in this vicinity in recent years" and they believe this species to be extremely rare.

The northern limit of the Highlands tiger beetle's known range is near Snell Creek north of Lake Marion, about 4 miles east of Haines City (Knisley and Hill 1996). This is near a unit of the Lake Wales Ridge NWR. The beetle has been found southeast of Lake Marion, in the vicinity of the Poinciana development, and in the Allen David Broussard Catfish Creek Preserve east of Lake Pierce and northeast of Lake Wales. The range continues south through The Nature Conservancy's Tiger Creek Preserve, the Lake Wales Ridge State Forest's Walk-in-Water tract, Lake Weohyakapka and the west side of Lake Arbuckle (Lake Wales Ridge State Forest), and Carter Creek (Lake Wales Ridge Wildlife and Environmental Area), to the vicinity of Josephine Creek (Jack Creek tracts managed by the Southwest Florida Water Management District and the adjoining Henscratch tract of the Lake Wales Ridge Wildlife and Environmental Area).

This species' narrow distribution may be in part due to its lack of dispersal. "Among tiger beetles there is a general trend of decreasing flight distance with decreasing body size (Pearson pers. comm.). *Cicindela highlandensis* is one of the smallest tiger beetles and an extremely weak flier (usually flying moving only five to ten meters) . . . . Species in woodland, scrub or dune habitats seem to disperse less than water edge species, and this could further explain the apparent limited dispersal of *C. highlandensis*." (Knisley and Hill 1996). The thermal requirements of the Highlands tiger beetle may also limit its dispersal. Adults may overheat in full sun. They prefer partially shaded habitats. Larval burrows tend to be near vegetation, where they are shaded for part of the day.

Knisley (2005) found the range of the Highlands tiger beetle is restricted to the core of the Lake Wales ridge and nearly separate from that the Florida scrub tiger beetle, which borders the range of the former species on all sides and extends well beyond the ridge. At several locations (few Lake Arbuckle sites and Henscratch), these two species were found to overlap or be contiguous (Knisley 2005). Results of the most recent surveys further suggest the distribution pattern of these two species may be determined by scrub height and elevation preferences; the Florida scrub tiger beetle occurs in scrub that is low in plant height and at lower elevations, and the Highlands tiger beetle prefers higher scrub where more shade is available and at higher elevations (Knisley 2005). *Cicindela hirtilabris* (no common name) is the most widely

distributed of the scrub species and co-occurs with both and at many sites where the other two species do not exist (Knisley 2005). This species also ranges further north than the other species.

Population Estimates/Status: Knisley and Hill (1996) used a mark-recapture method to estimate population sizes. The largest populations they observed were at Catfish Creek, where four nearby sites yielded an estimated total of 841 adults. Most of the sites had only very small to medium sized populations, evidently because most of the sites have very little suitable habitat due to the vegetation being too thick, or of low quality. Fortunately, small populations may be viable. Knisley and Hill monitored the northeastern beach tiger beetle (*Cicindela dorsalis dorsalis*), a federally threatened species, for nine years. Their data suggest that to be viable in the face of randomly-occurring events, populations must have at least 500 to 600 adults. But Arizona grassland tiger beetles that Knisley and others have studied typically exist at lower densities and can probably maintain themselves at smaller population sizes. In the absence of population viability studies, it seems likely that a population of about 100 adult Highlands tiger beetles in an area of 1 to 2 hectares (roughly 2 to 4 acres) can persist over the long term (Knisley and Hill 1996).

Knisley (2005) surveyed all known and additional sites (72) throughout the range of the Highlands tiger beetle in Polk (45) and Highlands (27) Counties in 2004 and 2005 to determine its current abundance, distribution, and conservation status. A total count of 1,574 adults was found at 40 sites compared with 643 adults at 31 sites in 1996, 928 adults at 31 sites in 1995, and 742 adults at 21 sites in 1993 (Knisley 2005). Of the 40 sites in the 2004-2005 surveys with one or more adults: three sites were found to have large populations of over 100 adults [Catfish Creek Preserve (493), Snell Creek South (193), and Flaming Arrow Scout Camp (175)]; three sites had populations of 50-99 adults; eight sites had 20-49 adults, 13 sites had 10-19 adults, and 13 sites had < 10 adults (Knisley 2005). Results from a limited removal study at four sites suggest that the actual population size at the various survey sites is likely to be as much as two times as high as indicated by the visual index counts (Knisley 2005). Knisley (2005) found that some sites with larger populations had additional habitat not previously surveyed and probably larger numbers than the survey indicated.

Overall, Knisley (2005) found evidence for a significantly improved conservation status of the Highlands tiger beetle in the 2004-2005 survey compared to the 1996 survey. He attributes the improvement to the addition of several new and good quality sites, which support medium or larger populations of the Highlands tiger beetle, and the improvement of the habitat quality due to management activity at several other sites. In 2004-2005 there were five sites with A grades and seven with B grades compared to three sites with A grades and five sites with B in 1996 (Knisley 2005). Some of these sites have been protected through State or Federal acquisition. In addition, there has been a loss of only a few small or lower quality sites and/or decrease in habitat quality and beetle numbers (Knisley 2005). Overall, additional improvement in the status of the Highlands tiger beetle could be made with even limited management at most sites, which could increase habitat quality and beetle numbers (Knisley 2005).

THREATS:

A. The present or threatened destruction, modification, or curtailment of its habitat or range. The Highlands tiger beetle depends on open, sandy areas within the Lake Wales Ridge's upland vegetation. This vegetation has largely been converted to citrus groves and residential areas. Peroni and Abrahamson (1985) used aerial photography to determine that in Highlands County 64.2 percent of the xeric vegetation (scrub, scrubby flatwoods, and high pinelands) present before settlement had been destroyed by 1981. Thus, by the time the Highlands tiger beetle was described as a new species in 1984, much of its potential habitat had already been destroyed.

An estimated two-thirds of habitat has been destroyed, and much of the remaining is degraded (NatureServe 2005). However, it is unlikely that the species has declined by only two thirds and it is possible that it has declined by more than 90 percent (NatureServe 2005). The main threat to this species is loss, degradation, and fragmentation of most remaining habitat, which is subject to destruction due to development and citriculture (Nature Serve 2005). Of more than 30 sites supporting the species, at least nine are less than one hectare (2.47 acres) in size (Nature Serve 2005). The threat of habitat loss is also in the form of increasing vegetation density from ecological succession and fire suppression (NatureServe 2005).

Lack of management of the remaining scrub and high pineland vegetation may constitute a threat as serious as habitat loss (Knisley and Hill 1992a, 1992b, 1996). The vegetation in which the Highlands tiger beetle occurs is subject to fire, ranging from relatively frequent and low-intensity in high pineland to infrequent and high intensity in some scrub (Myers and Ewel 1990). Years of fire suppression in most upland habitats of the Lake Wales Ridge led to the vegetation becoming much thicker, with few patches of bare ground. One indicator of ecological problems caused by fire suppression is that small scrub plants (herbs and smaller shrubs) are now typically most abundant in artificially disturbed areas such as firebreaks.

Implementing burning schedules should create more open habitat and benefit the species (Knisley 2005). However, it is uncertain if the method or time of burning has had negative effects on the Highlands tiger beetle. Knisley (2005) suggest that burning conducted during the period of adult activity, mid-May through July, in areas with adults would very likely cause some mortality to adults that cannot escape (by flying) from fire. In addition, fire and its immediate after effects might also make the habitat unsuitable for larval recruitment because of adult mortality and, perhaps more importantly, the disturbance to oviposition from burning activities (Knisley 2005). Knisley (2005) suggests that larvae, which live in burrows, may not be affected by the burning. According to Knisley (2005), the negative impacts from burning would probably be countered by improved habitat conditions within 1-2 years, and increase in the populations.

The Highlands tiger beetle is largely restricted to artificially disturbed areas. Knisley and Hill (1992a) noted that "our surveys for this species revealed that most sites we checked were very densely vegetated, a feature which we believe contributes to the low numbers of *C. highlandensis* we typically found. We have recently documented how the decline and local

extirpation of tiger beetle species (Knisley and Hill 1992[b]). One example we present is the extirpation of *C. abdominalis* (the species to which *highlandensis* is most closely related) at a Virginia pine barrens site in the 1930's from encroaching vegetation from succession and fire suppression." Knisley (2005) suggests that scraping or cutting of trails or open areas will cause some mortality to adults and especially larvae, but that the population would probably recover and increase in numbers within a few years of this disturbance.

Invasion by non-native species is a lesser threat, but one that appears to be increasing. During 1997-1998, Archbold Biological Station staff and volunteers controlled invasions of air potato (*Dioscorea bulbifera*), Brazilian pepper (*Schinus terebinthifolius*), rosary pea (*Abrus precatorius*), and feral hogs (Lohrer 1999). Cogon grass (*Imperata cylindrica*) is a serious problem throughout the state (Langeland and Burks 1999).

While trails for fire management or recreational purposes (all-terrain vehicles or four-wheeling) may provide needed open habitat for the Highlands tiger beetle (Knisley and Hill 1992a), vehicular activity has harmed beach-dwelling tiger beetles in the northeastern United States. Larvae live in burrows near the ground surface and may be harmed by local off-road vehicle traffic (NatureServe 2005).

Land acquisition by the State of Florida, the Service, and others has placed most of the good quality Highlands tiger beetle habitat in public or other conservation ownership. Habitat loss, while very serious, has been addressed, especially by the State in cooperation with local government. State land managers are implementing prescribed fire programs, exotic pest plant control, and visitor management, which should benefit this species. While habitat loss and modification created serious threats to this species, substantial progress has been made toward lessening the threats.

B. Overutilization for commercial, recreational, scientific, or educational purposes.
Members of the genus *Cicindela* may be the subject of more intense collecting and study than any other single insect genus. Knisley and Hill (1992a) stated that overcollecting of the Highlands tiger beetle may be of "some importance" and suggest that overcollecting may have been partly responsible for the apparent extirpation of the species from the site where Choate had first collected it (i.e., the type locality). They estimated that well over 1,000 adults had been collected at this site (Knisley and Hill 1996). Collecting appears to be a significant threat to this species (NatureServe 2005).

C. Disease or predation.
No diseases are known to threaten the Highlands tiger beetle. It is likely that the Highlands tiger beetle experiences the limiting effects from natural enemies and generally low survivorship that are seen for other tiger beetle species (Knisley and Hill 1996). In general, parasites are considered to have greater effects on tiger beetles than predators (Nagano 1982, Pearson 1988). While predators and parasites play important roles in the natural dynamics of tiger beetle populations, the small sizes of Highlands tiger beetle populations may render them vulnerable to predation and parasitism that would otherwise constitute a normal part of their environment.

The main natural enemies of adult tiger beetles are robber flies (Family Asilidae) and birds. Parasitoid wasps (Family Tiphiidae, genus *Methocha*) and bombyliid flies (genus *Anthrax*) are the main predators of larvae (Knisley and Hill 1989, Hill and Knisley 1990). Ants may sometimes affect larvae, especially during first instar (a stage in the life of an arthropod between two successive molts) (Knisley 1987). Most tiger beetles species that have been intensely studied experienced relatively high levels of larval parasitism (10 to over 40 percent) (Knisley and Hill 1992).

D. The inadequacy of existing regulatory mechanisms.
Regulatory mechanisms currently in effect do not adequately protect the Highlands tiger beetle and its habitat. The Florida Fish and Wildlife Conservation Commission has not listed this insect, nor are there other state or local regulatory mechanisms. Because the Highlands tiger beetle is not listed at the State or Federal levels, nothing prohibits importing, exporting, sale, or trade of the species. Colleting has the potential to threaten this species.

E. Other natural or manmade factors affecting its continued existence.
Populations of the Highlands tiger beetle are isolated and appear to occupy relatively small patches of habitat. Because increased extinction rates are directly correlated with reduction of available habitat area and increased distances between small populations (Gilpin 1987), the small, isolated populations of the Highlands tiger beetle may be vulnerable to local extinction from normal fluctuations in population size, genetic problems from small population size, or environmental catastrophes. Researchers believe that small populations of about 100 adult Highlands tiger beetles in an area of 1 to 2 hectares (roughly 2 to 4 acres) can persist over the long term (Knisley and Hill 1996). However, population sizes of the Highlands tiger beetle have not been studied in detail, and metapopulation viability studies have not been conducted. The small sizes of occupied habitat also reduce the ability of the habitats to buffer against edge effects and other influences from adjacent developed areas, such as pesticide drift. The difficulty of dispersal between suitable patches of habitat may also result in local extinctions of Highlands tiger beetle. Knisley and Hill (1992a) note that "tiger beetles, like many other insects, experience extreme year-to-year fluctuations in abundance such that small or moderate populations may be subject to natural extinctions. Our studies with *C[icindela] dorsalis* (and *C. puritana*), two federally listed species [of tiger beetles], indicate that 2 to 3-fold differences in abundance are common and that local extinctions and colonization of new sites occur. The presence of numerous populations within an area is important for the survival of this species by providing for repeated immigration, dispersal, and colonization sites critical for the population dynamics of this species (Hill and Knisley 1990). The extirpation of both of these species from most of their ranges in the Northeast seems to have been the result of gradual reductions and fragmentation of habitats which eventually prevented successful recolonization and supplementation of the few surviving populations. Populations of *C. highlandensis* [Lake Wales Ridge tiger beetle] already appear to be highly fragmented in scattered areas of small habitat patches . . . and subject to genetic decline and other related problems for small, isolated populations." As noted in the Background section, the Highlands tiger beetle is one of the smallest tiger beetles and appears to be a weak flier, meaning it probably disperses

over short distances.

No assessment has been made of possible threats to Highlands tiger beetle from maintenance of fire lanes, recreational use of off-road vehicles, and possibly pedestrian traffic. Vehicle and pedestrian traffic is a problem for tiger beetles on Florida beaches (Choate 1996). Populations of a tiger beetle species found in the northeastern United States, *Cicindela dorsalis dorsalis*, were extirpated in several localities that were subjected to heavy recreational use (i.e., heavy pedestrian foot traffic and vehicular use), but survived at sites that had received little or no recreational disturbance (Knisley and Hill 1992a). Since larvae of the Highlands tiger beetle live in burrows near the ground surface, this species may be harmed by local off-road vehicle traffic (NatureServe 2005).

Pesticides could pose a serious threat to the Highlands tiger beetle, most likely from aerial drift from homes and citrus groves, and also possibly from illicit dumping of waste. Highlands tiger beetle populations are on a variety of sites, ranging from large, contiguous tracts of conservation lands to conservation lands with numerous in-holdings, to some privately owned sites. Illicit waste dumping is a documented problem at several sites, including the Flamingo Villas tract of the Lake Wales Ridge NWR, where boundary fencing is planned to discourage unauthorized access. The effects of insecticides on other tiger beetle species are summarized by Nagano (1982). Mosquito spraying may well be or become a serious threat to the species at some or most of its sites (NatureServe 2005). As urban development increases near or in Highlands tiger beetle habitat, negative impacts from pesticides may become more frequent.

CONSERVATION MEASURES PLANNED OR IMPLEMENTED

The State of Florida has acquired a number of sites that are occupied by the Highlands tiger beetle, including those listed above. The Service is continuing to purchase individual lots at the Flamingo Villas tract of Lake Wales Ridge NWR, and funds may be available to protect that site by fencing it. Land managers in the Lake Wales Ridge area have begun to conduct more prescribed burning to enhance or restore scrub habitat. With these efforts, tiger beetle habitat may be improving. The Service has also funded a survey by Dr. Barry Knisley, which was completed in October 2005.

SUMMARY OF THREATS

Habitat loss, degradation, and fragmentation have destroyed much of the Highlands tiger beetle's historic range, and these threats are continuing. Although most of the largest populations occur on conservation lands, the specific habitat requirements of the Highlands tiger beetle make its continued persistence uncertain. Increasing vegetation density from ecological succession and fire suppression remain as threats to this species. The Highlands tiger beetle is inherently vulnerable to extinction due to the small sizes of its populations. Mosquito control and pesticides are likely serious threats to the species. In addition, collecting appears to be a significant threat.

For species that are being removed from candidate status:

___Is the removal based in whole or in part on one or more individual conservation efforts that

you determined met the standards in the Policy for Evaluation of Conservation Efforts When Making Listing Decisions (PECE)?

RECOMMENDED CONSERVATION MEASURES

- Continued acquisition and protection of Highlands tiger beetle habitat by private, County, State, and Federal entities (Knisley 2005).
- Implementing burning schedules as part of land management practices on conservation lands to create and maintain more open habitat. However, the method and timing of burns may have negative effects. For example, burns conducted during the period of adult activity (mid-May through July) in areas of with adults may cause some mortality (Knisley 2005).
- Cutting or scraping new trails and / or open areas throughout sites to create more open habitat for the Highlands tiger beetle (Knisley 2005).
- Limiting pesticide use in and around Highlands tiger beetle habitat.
- Limiting off-road vehicle use in and around Highlands tiger beetle habitat to protect larvae.
- Limiting over-collecting at sites through increased monitoring of sites or regulations.
- Minimizing trash dumping in Highlands tiger beetle habitat through regulations, increased fines, and / or posting of signs marking boundaries of conservation lands.

LISTING PRIORITY

THREAT			
Magnitude	Immediacy	Taxonomy	Priority
High	Imminent	Monotypic genus	1
		Species	2
		Subspecies/population	3
	Non-imminent	Monotypic genus	4
		Species	**5***
		Subspecies/population	6
Moderate to Low	Imminent	Monotypic genus	7
		Species	8
		Subspecies/population	9
	Non-imminent	Monotypic genus	10
		Species	11
		Subspecies/population	12

Rationale for listing priority number:

Magnitude: This is a very narrowly distributed species, with very small populations that are restricted to open, sunny areas that are inherently impermanent. While managers of conservation lands understand the need to restore overgrown areas of scrub vegetation through fire and

mechanical means, there is still a considerable amount of work to do. The Highlands tiger beetle is inherently vulnerable to extinction due to the small sizes of populations.

Imminence: Purchases of suitable habitat for State conservation lands and Lake Wales Ridge National Wildlife Refuge have improved prospects for this species, and management programs on these sites may be forestalling the threat of vegetation encroaching into bare sand areas needed by the Highlands tiger beetle. Although we have not received recent reports of this beetle being collected, collecting appears to be a significant threat (NatureServe 2005). Although these are actual, identifiable threats, sufficient conservation efforts are being made to consider them as "non-imminent."

Yes Have you promptly reviewed all of the information received regarding the species for the purpose of determining whether emergency listing is needed?

Is Emergency Listing Warranted? No. A complete status survey completed in October 2005 suggests that the status of the Highlands tiger beetle has improved (Knisley 2005).

DESCRIPTION OF MONITORING

The Service is continuing with acquisition of conservation lands on a lot-by-lot basis at Carter Creek and Flamingo Villas of the Lake Wales Ridge NWR. We are also assisting the State with acquisition efforts within the Lake Wales Ridge Ecosystem and Bombing Range Ridge projects under the Florida Forever Program. Efforts by the Service and the State have the potential to secure habitat for the Highlands tiger beetle. Continued acquisition remains the greatest need for accomplishing the long-term protection and recovery of this species on the Lake Wales Ridge.

Due to a lack of recent information on the species' status, the Service funded a rangewide survey for the Highlands tiger beetle by a recognized species expert, Dr. Barry Knisley, in 2004. Specific objectives of this status survey included: determining the current distribution and abundance of the Highlands tiger beetle, including adult population sizes, potential habitat, and utilized habitat at each site; estimating larval abundance and recruitment at all sites with medium to large populations; determining the threats and limiting factors to the habitat and the beetle population at each site and re-examining relevant biological characteristics of the species; and, providing site-specific management recommendations for protection and recovery of the species. Results of the 2004-2005 study suggest that the status of the Highlands tiger beetle has improved since its last survey in 1996 (Knisley 2005).

The Service participates as a member of the Lake Wales Ridge Ecosystem Working Group, a cooperative group comprised of private, local, State, and Federal entities interested in identifying and addressing sources of concern and threats to the health of the Lake Wales Ridge Ecosystem. The Lake Wales Ridge Working Group and its subgroups (Listed Species, Fire, Exotics, and Education) focus on restoration and management of lands throughout the Lake Wales Ridge Ecosystem. Although this group includes managers of all conservation lands within the range of the Highlands tiger beetle, monitoring specifically for this species was not reported during the year by any members of this group.

Land managers in the Lake Wales Ridge area have begun to conduct more prescribed burning in recent years to enhance or restore scrub habitat. Prescribed burning on private and public conservation lands has likely improved habitat for this species and may provide improved habitat conditions in the future. At this time, the Service is not proposing a change in status.

COORDINATION WITH STATES

Indicate which State(s) (within the range of the species) provided information or comments on the species or latest species assessment: None.

Indicate which State(s) did not provide any information or comments: Florida (form has not been sent to the Florida Fish and Wildlife Conservation Commission).

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APPROVAL/CONCURRENCE: Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes, including elevations or removals from candidate status and listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all resubmitted 12-month petition findings, additions or removal of species from candidate status, and listing priority changes.

Approve: /s/ Jeffrey M. Fleming 11/16/2005
Acting Regional Director, Fish and Wildlife Service Date

Concur: _____ August 23, 2006
Acting Director, Fish and Wildlife Service Date

Do Not Concur: _____ _____
Director, Fish and Wildlife Service Date

Date of annual review: October 2005

Conducted by: South Florida (Vero Beach) Field Office